Active Project (2014 - 2016)

Fiber Optic Shape Sensing for Tethered Marsupial Rovers, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Building upon the successful proof of concept work in Phase I, Luna Innovations Incorporated is proposing to design, build, and test a sensing tether for marsupial rovers. This tether will be capable of monitoring its own distributed tension, curvature, length, and shape, enabling greater flexibility in robotic exploration and sample-gathering missions conducted on remote planets and moons. By providing information about elevation changes, potential points of harm and deployed length, the sensing tether will add crucial information during the course of the mission. The distributed tension and curvature measurements are particularly useful, as they indicate when the rover has become stuck, descended a slope or lost traction. Luna's sensing tether has the ability to measure its own path as it stretches between the marsupial rover and its base, giving position and orientation information not just on the tether, but also on the attached rover. Made from a single strand of custom optical fiber, Luna's shape fiber is lightweight and flexible, easily fitting inside existing tether packages.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The NASA niche market for self-sensing tethers is focused on missions featuring robotic exploration, especially the Axel rover.[1] NASA is planning specific missions including Mid-Size Rovers, Astrobiology Field Lab, Network Landers, Europa Explorer, and Titan-Enceladus Explorer,[2] to bring back samples from comets, asteroids, and the lunar south polar basin, and Mars. Market opportunities for tethered rovers within NASA often coincide with Mars exploration missions that are launched every 26 months. Prime contractors supporting NASA's rover missions include Lockheed Martin Astronautics.[3] While Luna's technical development of self-sensing tethers is focused to meet the specific needs of NASA as an early adopter, there is a wide and

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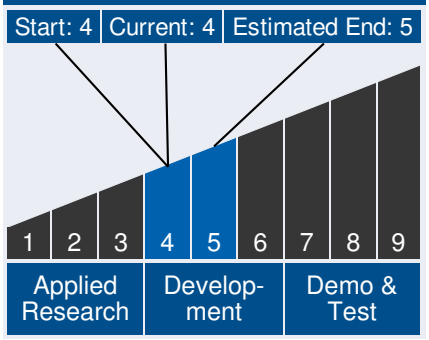
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

diverse market for self-sensing tethers to support robotic inspection in challenging Earth environments.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Luna is already actively engaged the market for short-range distributed fiber optic shape and position sensing though minimally invasive surgery (MIS) development efforts with Intuitive Surgical, Inc. and Philips Medical. Luna's preliminary long-range sensing capabilities has also generated interest among makers and end-users of robotic exploration tools, UUVs, pipe crawlers, and articulated borescopes. These potential customers, including industry leaders in aerospace, NDT inspection, and ship building, have all expressed the need for 3D shape and position sensing in a lighter, more flexible, durable, and most importantly, longer form. Phase I efforts have proved the feasibility of making continuous shape measurements out to lengths up to 100m. The upgraded acquisition system and software, integration into a rugged cable, in-the-field testing gained through the Phase II effort will move this technology closer to industry adoption.

Management Team *(cont.)*

Project Manager:
- Robert Jones

Principal Investigator:
- Shirley Evans

Technology Areas

Primary Technology Area:
Robotics and Autonomous Systems (TA 4)
└ Mobility (TA 4.2)
  └ Robot Navigation (TA 4.2.6)
    └ Autonomous Navigation for Tethered Systems (TA 4.2.6.2)

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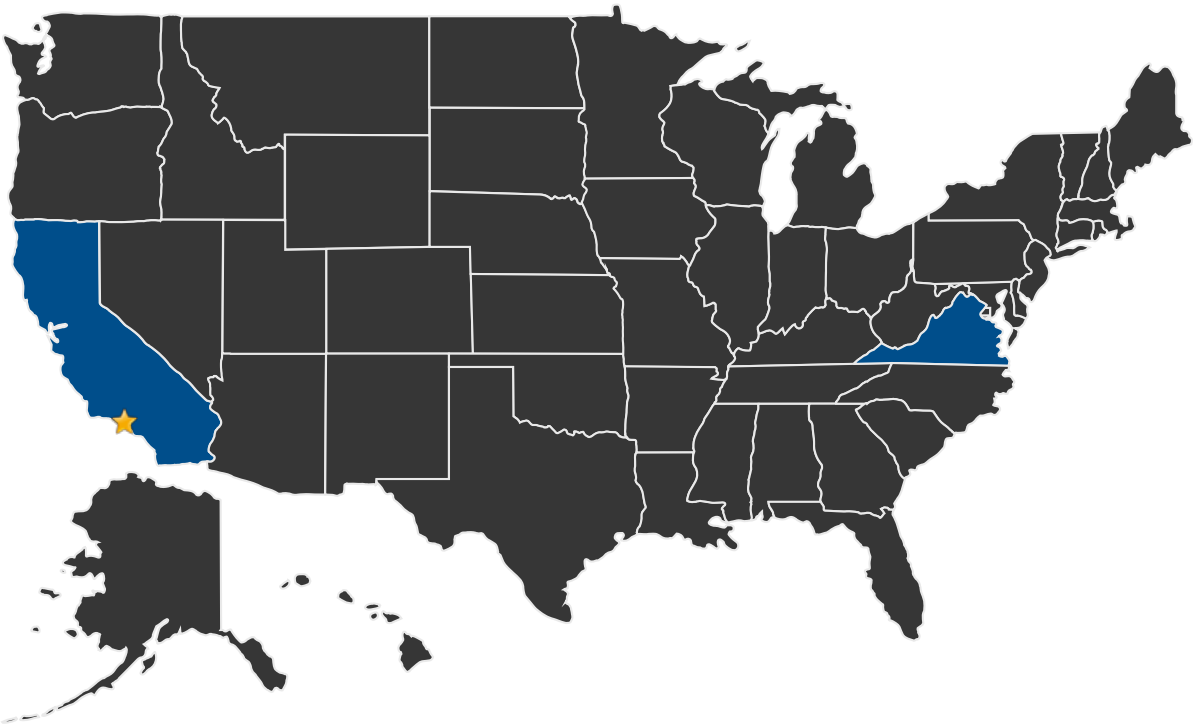
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Jet Propulsion Laboratory

Other Organizations Performing Work:

- Luna Innovations, Inc. (Roanoke, VA)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/22943)

IMAGE GALLERY

Fiber Optic Shape Sensing for Tethered Marsupial Rovers, Phase II

DETAILS FOR TECHNOLOGY 1

Technology Title

Fiber Optic Shape Sensing for Tethered Marsupial Rovers

Potential Applications

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